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[Superseeding IS : 1980-1967 &
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Indian Standard

SPECIFICATION FOR CERAMIC DIELECTRIC CAPACITORS, TYPE I

PART 1 GENERAL REQUIREMENTS AND METHODS OF TESTS

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NEW DELHI 110002

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Indian Standard

SPECIFICATION FOR CERAMIC DIELECTRIC CAPACITORS, TYPE I

PART 1 GENERAL REQUIREMENTS AND METHODS OF TESTS

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Indian Standard

SPECIFICATION FOR CERAMIC DIELECTRIC CAPACITORS, TYPE I

PART 1 GENERAL REQUIREMENTS AND METHODS OF TESTS

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 25 September 1975, after the draft finalized by the Capacitors and Resistors for Electronic Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard (Part II) lays down methods of tests and requirements for judging the performance of ceramic dielectric capacitors, Type 1 suitable for use in resonant circuits or any other applications where low loss and high stability are essential.

0.2.1 Dimensional requirements of ceramic dielectric capacitors, Type 1 are not at present covered in this standard.

0.3 The specification for ceramic dielectric capacitors was originally covered by IS : 1980-1967*. This standard supersedes IS : 1980-1967* which was prepared originally to cover ceramic dielectric capacitors. This standard follows closely the IEC Publication 108-1967 '·Recommendation for ceramic dielectric capacitors, Type 1 ', issued by International Electrotechnical Commission.

0.4 In addition to improving certain performance characteristics, the major factors of this standard in comparison to IS : 1980-1967* relate to the following:

a) Reviewing the climatic categories of the component,

b) Aligning the rated voltage values with those in the corresponding IEC Publications, and

c) Prescribing the requirements for those which have been kept open either due to non-availability of data or investigation.

0.5 General requirements and tests are covered in IS : 7305 (Part I)-1973†, which is a necessary adjunct to this standard.

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*Specification for ceramic dielectric capacitors, Type 1 (*first revision*).

†Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

0.6 This standard requires reference to IS : 589-1961* in which details of the various climatic tests prescribed have been fully covered. Only the appropriate degrees of severity and any other special conditions relating to climatic and mechanical tests have been included in this standard.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part II) prescribes the requirements for judging the electrical, mechanical and climatic properties of ceramic dielectric capacitors, Type 1 (*see* **3.1**) intended for use in electronic and telecommunication equipment.

1.1.1 This standard does not lay down dimensional requirements of such capacitors.

1.1.2 Capacitors for radio frequency currents exceeding 1A or reactive power exceeding 200 var are not covered by this standard.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions in addition to those covered in IS : 7305 (Part I)-1973‡ shall apply.

2.1 Type 1 Capacitors — Capacitors suitable for use in resonant circuits or any other applications where low losses and high stability are essential.

2.2 Type 2 Capacitors — Capacitors suitable for by-pass and coupling applications or in frequeney discriminating circuits where low loss and high stability of the capacitors are not of major importance.

3. TYPES

3.1 The ceramic dielectric capacitors Type 1 shall be further subdivided as follows:

Type 1A — For temperature compensating purposes where standard values of temperature coefficient with close tolerances on the temperature coefficient are essential.

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*Basic climatic and mechanical durability tests for electronic components (*revised*).

†Rules for rounding off numerical values (*revised*).

‡Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

Type 1B — For general purpose, where standard values and tolerances for temperature coefficient are suitable.

Type 1C — For general purpose, where wide tolerances on temperature coefficient are acceptable.

Type 1D — Same as Type 1C, but with still wider tolerance on temperature coefficient.

4. CATEGORIES

4.1 Capacitors covered by this standard shall belong to one of the following three categories based on their ability to withstand the climatic severities:

Climatic Test (*see* IS : 589-1961*)	*Severities*			
	Category 1		Category 2	Category 3
	A	B		
Dry heat	+125	85°C	+85°C	+70°C
Cold	−55°C	−55°C	−40°C	−10°C
Damp heat (long term)	56 days	56 days	21 days	10 days
Damp heat (accelerated)	6 cycles	6 cycles	2 cycles	1 cycle
Rapid change of temperature	+125 to −55°C	+85 to −55°C	+85 to −40°C	Not applicable
Low air pressure	44 mbar	44 mbar	85 mbar	600 mbar

Note — In case of special requirements where the above categories cannot be applied strictly, the other combinations of severities may be agreed to between the manufacturer and the purchaser provided such severities are chosen from IS : 589-1961*.

5. RATINGS

5.1 Rated Capacitance — The values of rated capacitance shall be in accordance with **4.1.1** of IS : 7305 (Part I)-1973†.

---

*Basic climatic and mechanical durability tests for electronic components (*revised*).

†Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

5.1.1 *Tolerance on Rated Capacitance* — The permissible tolerances on rated capacitance values shall be as follows:

Tolerance		*Preferred Series*
$C_R > 10$ pF percent	$C_R \leqslant 10$ pF pF	
20	2	E 6
10	1	E 12
5	0·5	
2	0·25	E 24
1	0·1	

5.2 Rated Temperature Coefficient

5.2.1 The rated temperature coefficients for Types 1A and 1B and the associated tolerances are given in Table 1 in parts per million per degree Celcius.

5.2.2 The temperature coefficients of Types 1C and 1D capacitors shall be between the following limits:

Type 1C — Between +140 and −870 ppm/°C

Type 1D — Between +250 and −1 750 ppm/°C

5.3 Rated Voltage — The values of rated voltages shall be chosen from R5 series of IS : 1076-1967* with the addition of the values 50 V and 500 V from the R10 series. If other values are required they shall be chosen from R10 series.

5.4 Rated Temperature — The upper category temperature of the relevant category shall be the rated temperature for ceramic capacitors covered by this standard.

6. CONSTRUCTION AND WORKMANSHIP

6.1 The construction and workmanship shall be in accordance with **5** of IS : 7305 (Part I)-1973†.

7. DIMENSIONS

7.1 The dimensions shall be checked and shall comply with those specified by the manufacturer.

Note — Standard dimensions are under consideration.

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*Preferred numbers (*first revision*).

†Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

TABLE 1 TEMPERATURE COEFFICIENT AND THE ASSOCIATED TOLERANCE FOR TYPES 1A AND 1B CAPACITORS

(*Clause* 5.2.1)

Temperature Coefficient	Tolerances on Temperature Coefficient				
	Type 1A, Rated Capacitance			Type 1B, Rated Capacitance	
	>20 pF	Exceeding 10 pF up to and including 20 pF	<10 pF	>20 pF	<20 pF
(1)	(2)	(3)	(4)	(5)	(6)
	ppm/°C	ppm/°C	ppm/°C	ppm/°C	ppm/°C
+$\underline{100}$	±15	±40	$^{+120}_{-40}$	±40	$^{+120}_{-40}$
+ 33	±15	±40	$^{+120}_{-40}$	±40	$^{+120}_{-40}$
+ $\underline{0}$	±15	±40	$^{+120}_{-40}$	±40	$^{+120}_{-40}$
− 33	±15	±40	$^{+120}_{-40}$	±40	$^{+120}_{-40}$
− 47	±15	±40	$^{+120}_{-40}$	±40	$^{+120}_{-40}$
− 75	±15	±40	$^{+60}_{-40}$	±40	$^{+60}_{-40}$
−$\underline{150}$	±15	±40	$^{+60}_{-40}$	±40	$^{+60}_{-40}$
−220	±20	±40	$^{+60}_{-40}$	±40	$^{+60}_{-40}$
−330	±25	±60	±60	±60	±60
−470	±35	±90	$^{+250}_{-90}$	±90	$^{+250}_{-90}$
−$\underline{750}$	±60	±120	$^{+250}_{-120}$	±120	$^{+250}_{-120}$
−1 500	±120	±250	±250	±250	±250

Note — The underlined values are preferred.

8. MARKING

8.1 Each capacitor shall be clearly marked with (a), (b) and (c) of the markings listed below and with as many as possible of the remaining items in the order indicated and as agreed to between the manufacturer and the purchaser:

a) Rated capacitance and tolerance on rated capacitance in clear or in code in accordance with Appendix A;

b) Temperature coefficient and if practicable its tolerance in code in accordance with Appendix A;

c) Rated voltage (U_R);

d) Type, namely 1A, 1B, etc;

e) Manufacturer's name or trade-mark;

f) Indication of appropriate category according to this standard;

g) Week (or month) and year of manufacture (this may be in code form);

h) Manufacturer's type designation; and

j) Any other marking if required by the purchaser.

8.1.1 *Coded Marking*

8.1.1.1 When a colour code is used, it shall be in accordance with Appendix A.

8.2 All the information specified in **8.1** shall be marked on the packing of the capacitors. Any additional markings on the capacitor or its packing or both shall be so applied as not to cause confusion.

8.2.1 The capacitors may also be marked with the Standard Mark.

8.2.2 The use of the Standard Mark is governed by the provision of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

9. TESTS

9.1 Classification of Tests

9.1.1 *Type Tests*

9.1.1.1 *Type approval procedure* — The procedure for type approval shall be in accordance with IS : 2612-1965*.

9.1.1.2 *Number of samples* — The manufacturer shall submit 40 samples of capacitors of each category, and temperature coefficient, equally divided between:

a) The maximum capacitance at its highest appropriate voltage, and

b) The maximum working voltage at its highest appropriate capacitance.

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*Recommendation for type approval and sampling procedures for electronic components.

9.1.1.3 *Sequence of type tests* — The sequence of type tests shall be in accordance with Appendix B.

9.1.2 *Acceptance Tests* — Two groups of samples, one for non-destructive tests (Group A) and the other for destructive tests (Group B), shall be selected (*see* Appendix B of IS : 2612-1965*) and the capacitors in each group shall be subjected to the tests specified below:

Group A (Non-destructive)

a) Temperature coefficient (**9.3.3**)
b) Insulation resistance (**9.3.4**)
c) Voltage proof (high voltage) (**9.3.5**)
d) Short-term stability (**9.3.7**)
e) Dimensions (**9.4.2**)

Group B (Destructive)

a) Robustness of terminations (**9.4.3**)
b) Soldering (**9.4.4**)
c) Climatic sequence (**9.5.1**)

9.1.3 *Routine Tests* — The following tests shall be the routine tests:

a) Tangent of loss angle (**9.3.2**),

b) Capacitance (**9.3.1**),

c) Voltage proof (high voltage) (as a flash test) (**9.3.5**), and

d) Visual examination (**9.4.1**).

9.2 General Conditions for Tests — The general conditions for tests shall be as specified in **7.2** of IS : 7305 (Part I)-1973†.

9.3 Electrical Tests

9.3.1 *Capacitance* — The capacitance (*C*) shall be measured with the help of a bridge or any other suitable means and corrected, if necessary by calculation, to the reference temperature of 25°C using the nominal temperature coefficient. The standard frequency for measurement shall be 100 kHz ± 5 percent or 1 MHz ± 5 percent. The standard frequency for referee purposes shall be 1 MHz. The measuring method shall be such that the error does not exceeed:

a) for $C \leqslant 1\,000$ pF 1 MHz ± 20 percent

b) for $C > 1\,000$ pF 1 KHz ± 20 percent

The applied voltage shall not exceed 5 V.

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*Recommendation for type approval and sampling procedures for electronic components.

†Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

NOTE 1 — For capacitors with a rated capacitance, of less than 10 pF, the method of measurement and the interpretation of the results shall be agreed to between the purchaser and the manufacturer.

NOTE 2 — When measurements are made before and after a test, the apparatus and method employed shall be the same in each case.

The capacitance value shall correspond with the rated capacitance, taking into account the tolerance.

9.3.2 *Tangent of Loss Angle* — This test shall be made in accordance with **7.3.3** of IS : 7305 (Part I)-1973*. The frequency for the measurement shall be as in **9.3.1**.

NOTE — The tangent of loss angle shall not be measured within 30 minutes of application of a dc voltage, for example, as applied in the measurement of insulation resistance.

The tangent of the loss angle shall not exceed the following values:

a) For capacitors with a rated capacitance (C) equal to or exceeding 50 pF	10×10^{-4}
b) For capacitors with a rated capacitance (C) (in pF) equal to or exceeding 5 pF but less than 50 pF	$\left(\frac{250}{C} + 7\right) 10^{-4}$

For capacitors with a rated capacitance of less than 5 pF, if a limit on the tangent of loss angle is required by the purchaser, the method of measurement and the interpretation of the results shall be agreed upon between the purchaser and the manufacturer.

9.3.3 *Temperature Coefficient* — This test shall be carried out in accordance with **7.6** of IS : 7305 (Part I)-1973*.

The temperature coefficient determined shall correspond with the rated temperature coefficient, taking into account its tolerance (for Types IA and IB) or lie within the appropriate limits (for Types 1C and 1D).

NOTE — For capacitance values so low that the above method is not accurate enough, it may be necessary to use a higher measuring frequency.

9.3.4 *Insulation Resistance* — This test shall be carried out in accordance with **7.3.6** of IS : 7305 (Part I)-1973*.

The voltage shall not be applied gradually but shall be applied at once through the internal resistance of the test apparatus. The product of this internal resistance (in megohms) and the rated capacitance value (in microfarads) of the capacitor under test shall not exceed one second.

The insulation resistance shall be not less than 20 000 MΩ.

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

9.3.5 *Voltage Proof (High Voltage)* — A direct voltage of the appropriate value specified below shall be applied for a period of one minute ±5 seconds. The circuit for this test shall be in accordance with **7.3.1** of IS : 7305 (Part I)-1973*:

For capacitors of rated voltage (U_R) less than or equal to 500 V	2·5 U_R
For capacitors of rated voltage (U_R) greater than 500 V	1·5 U_R + 500 V

NOTE — For special applications where more stringent requirements are desired, the test voltage specified for this test, if agreed to between the manufacturer and the purchaser may be 3 times the rated voltage for all capacitors.

The product of the internal resistance (in megohms) and the rated capacitance value (in microfarads) of the capacitor under test plus any parallel capacitance in the test apparatus shall not exceed one second.

The charging current of the capacitor under test shall not exceed 50 mA.

After the high voltage test, there shall be no breakdown of the capacitor nor any visible deterioration, such as overheating, melting or seepage of impregnant.

For routine tests the voltage shall be applied as a flash for a period of one second only.

9.3.6 *Loading (Optional Test)* — This test is applicable to capacitors used with appreciable RF current only. When required, the appropriate conditions (temperature and ratings) procedures and the test requirements, such as permissible temperature rise, change of capacitance and change of temperature coefficient shall be subject to agreement between the purchaser and the manufacturer.

9.3.7 *Short Term Stability (Scintillation)* — This test shall be carried out in accordance with **7.3.8** of IS : 7305 (Part I)-1973*.

9.4 Physical and Mechanical Tests

9.4.1 *Visual Examination* — The capacitors shall be visually examined for compliance with the requirements of marking and finish.

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

9.4.2 *Dimensions* — The dimensions shall be checked and shall comply with those specified by the manufacturer.

9.4.3 *Robustness of Terminations*

9.4.3.1 *Tensile test*

a) *Capacitors with axial terminations* — This test shall be carried out in accordance with **7.4.3.1** of IS : 7305 (Part I)-1973*.

b) *Capacitors with radial terminations*

1) *Radial* (*load applied radially*) — The body of the component shall be supported and the terminations should be loaded. The loading weight shall be 500 grams and applied gradually (*see* Fig. 1).

2) *Axial* (*load applied axially*) — Bend the leads close to the capacitor body so that they become located in the same plane as the capacitor body. The load should be stress-released at the point indicated by '*X*'. The loading weight shall be 250 grams and applied gradually (*see* Fig. 2).

c) *Final measurements* — Under consideration.

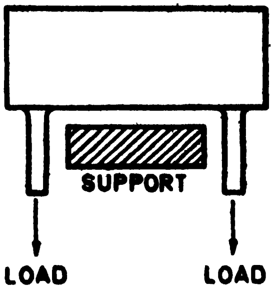

FIG. 1 RADIAL

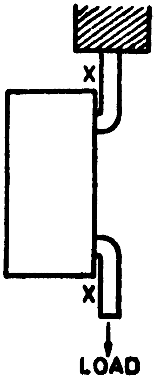

FIG. 2 AXIAL

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

9.4.3.2 *Bending test* — This test shall be carried out in accordance with **7.4.3.2** of IS : 7305 (Part I)-1973*.

9.4.3.3 *Torsion test* — This test shall be carried out in accordance with **7.4.3.3** of IS : 7305 (Part I)-1973*.

9.4.4 *Soldering* — The capacitor shall be dried and the capacitance shall be measured. This test shall be carried out in accordance with **7.4.4** of IS : 7305 (Part I)-1973*.

The capacitor shall be visually examined and there shall be no apparent damage and the termination shall get wet easily.

After the test, the capacitors shall be dried and stored for half-an-hour to one hour under standard atmospheric conditions.

Capacitance shall then be measured and change of capacitance compared with the value measured above shall not exceed 0·5 percent or 0·5 pF whichever is greater.

9.4.5 *Vibration* — The capacitors shall be mounted in accordance with **7.6.4.1** of IS : 589-1961† taking care that the terminal wires are not stressed and in such a manner that equal numbers of capacitors are vibrated along each of the three principal axes.

The capacitors shall be subjected to the vibration (fatigue) test in accordance with **7.6.6** of IS : 589-1961† for severity III. The capacitors shall be loaded with rated voltage throughout the test.

After the test the capacitors shall be visually examined. There shall be no visible damage.

9.4.6 *Bump* — This test shall be carried out in accordance with **7.4.7** of IS : 7305 (Part I)-1973*. The capacitors shall be loaded with rated voltage throughout the test.

After the test the capacitors shall be visually examined. There shall be no visible damage.

Capacitance, tangent of loss angle and insulation resistance shall be measured and shall satisfy the following requirements:

a) *Capacitance* — change not to exceed ±1 percent or 0·5 pF whichever is greater.

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

†Basic climatic and mechanical durability tests for electronic components (*revised*).

b) *Tangent of loss angle* — shall meet the initial requirements.

c) *Insulation resistance* — shall be not less than 10 000 megohms.

NOTE — A suitable method of monitoring is under consideration.

9.4.7 *Shock* — Under consideration.

9.4.8 *Acceleration* — Under consideration.

9.5 Climatic Tests

9.5.1 *Climatic Sequence*

9.5.1.1 *Initial measurements* — The capacitance, tangent of loss angle and insulation resistance shall be measured.

9.5.1.2 *Dry heat* — This test shall be carried out in accordance with **7.5.1.2** of IS : 7305 (Part I)-1973* with rated voltage applied.

After recovery, the capacitor shall be visually examined. There shall be no visible damage and the marking shall be legible.

9.5.1.3 *Damp heat* (*accelerated*) (*first cycle*) — This test shall be carried out in accordance with **7.5.1.3** of IS : 7305 (Part I)-1973*.

After recovery, the capacitor shall be visually examined. There shall be no visible damage and the marking shall be legible.

9.5.1.4 *Cold* — This test shall be carried out in accordance with **7.5.1.4** of IS : 7305 (Part I)-1973*. The duration of exposure shall be 2 hours.

The capacitors shall be removed from the cold chamber and visually examined. There shall be no visible damage. The markings shall be legible and indelible.

The capacitors shall remain under recovery conditions for 2 to 4 hours. They shall then be removed from the recovery chamber and shaken by hand to remove droplets of water.

9.5.1.5 *Low air pressure* — This test shall be carried out in accordance with **7.5.1.5** of IS : 7305 (Part I)-1973*. The duration of the test shall be one hour.

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

9.5.1.6 *Damp heat (accelerated) remaining cycles* — This test shall be carried out in accordance with **7.5.1.6** of IS : 7305 (Part I)-1973*.

NOTE — The remaining damp heat cycles required are as follows :

Category 1	5 cycles
Category 2	5 cycles
Category 3	1 cycle

After recovery the capacitance shall be visually examined. There shall be no visible damage and the marking shall be legible.

9.5.1.7 *Final measurements* — The capacitance, tangent of loss angle and insulation resistance shall be measured at the end of the climatic sequences.

The change of capacitance compared with the value measured in **9.5.1.1** shall not exceed the following limits:

a) 2 percent 2 pF whichever is greater for Type 1D capacitors and for capacitors with a temperature coefficient of —1 500 ppm/°C

b) 1 percent or 1 pF whichever is greater for all other capacitors.

The tangent of loss angle shall not exceed twice the value measured in **9.5.1.1**.

The insulation resistance shall be equal to or greater than the following values:

Categories 1 and 2	10 000 megohms
Category 3	5 000 megohms

9.5.2 *Damp Heat (Long Term Exposure)* — This test shall be carried out in accordance with **7.5.2** of IS : 7305 (Part I)-1973*. Duration of the exposure shall be appropriate to the category of the capacitor under test.

During the whole period of this test, a direct voltage equal to the rated voltage shall be applied to the terminals of half number of capacitors.

After recovery the capacitors shall be visually examined. There shall be no visible damage and the marking shall be legible.

Capacitors subjected to the voltage shall show no short circuit or open circuit.

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

The capacitance, tangent of loss angle, voltage proof, insulation resistance and solderability of capacitors not subjected to voltage shall be measured.

The change of capacitance compared with the initial values (*see* **9.3.1**) shall not exceed the following limits:

a) 2 percent or 2 pF whichever is greater for Type 1D capacitors and for capacitors with temperature coefficient of − 1 500 ppm/°C

b) 1 percent or 1 pF whichever is greater for all other capacitors.

The tangent of loss angle shall not exceed twice the value measured in **9.3.2**.

The insulation resistance shall be equal to or greater than the following values:

Categories 1 and 2	10 000 megohms
Category 3	5 000 megohms

9.5.3 *Rapid Change of Temperature* — This test is applicable to capacitors belonging to categories 1 and 2 only. This test is not applicable to Type 1D capacitors.

The capacitance of capacitors shall be measured.

This test shall be carried out in accordance with **7.5.3** of IS : 7305 (Part I)-1973*.

The capacitors shall then be subjected to voltage proof (high voltage) test in accordance with **9.3.4**.

The capacitance of the capacitor shall be measured. The change in capacitance shall be not greater than ±0·5 percent or 0·5 pF whichever is greater.

9.5.4 *Salt Mist* — This test shall be carried out in accordance with **7.5.5** of IS : 7305 (Part I)-1973*. The duration of the exposure shall be 4 days. The requirements shall be as stated in IS : 7305 (Part I)-1973*.

9.5.5 *Mould Growth* — This test shall be carried out in accordance with **7.5.4** of IS : 7305 (Part I)-1973* and shall satisfy the requirements specified in **7.9** of IS : 589-1961†.

9.5.6 *Storage* (*Normal*) — Under consideration.

9.6 Endurance Test — The capacitor shall be subjected to an endurance test of 2 000 hours in an atmosphere maintained at the upper category temperature with the rated voltage applied between the terminals.

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

†Basic climatic and mechanical durability tests for electronic components (*revised*).

9.6.1 The details of the test chamber shall be in accordance with **7.9** of IS : 7305 (Part I)-1973*.

9.6.2 The capacitance, the tangent of loss angle and the insulation resistance shall then be measured.

9.6.3 The change of capacitance compared with the value measured in **9.3.1** shall not exceed the following limits:

a) 2 percent or 2 pF whichever is greater for Type 1D capacitor and for capacitors with a temperature coefficient of —1 500 ppm/°C

b) 1 percent or 1 pF which ever is greater for all other capacitors.

9.6.4 The tangent of loss angle shall not exceed 1·5 times the value obtained in **9.3.2**.

9.6.5 The insulation resistance shall be not less than 3 000 megohms.

APPENDIX A

(*Clauses* 8.1 *and* 8.1.1.1)

COLOUR CODE FOR MARKING CERAMIC DIELECTRIC CAPACITORS

A-1. GENERAL

A-1.1 The colour code for ceramic dielectric capacitors of Type 1 shall be one of the following:

a) Five bands with a double spacing between the first and second band,

b) Five dots in line,

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*Specification for fixed capacitors used in electronic equipment: Part I General requirements and tests.

c) Six bands with a double spacing between the second and third band, or

d) Six dots in line.

A-1.2 The colour code shall be used to indicate the following:

a) Type, namely, Types 1A, 1B, 1C, or 1D;

b) The temperature coefficient and its tolerance;

c) The capacitance value; and

d) The tolerance as capacitance value.

A-1.2.1 If the rated voltage is other than 500 V, this shall be separately marked.

A-1.3 The colour code applicable to each type (*see* **3.1**) shall be:

a) for Type 1 ceramic dielectric capacitors with a standard temperature coefficient except +100, +33, −47 and −1 500 ppm/°C: five bands or dots (*see* **A-2.1**).

b) for Type 1 ceramic dielectric capacitors with a standard temperature coefficient of +100, +33, −47 and −1 500 ppm/°C: 6 bands or dots (*see* **A-3.1**), first two bands or dots being as given below:

Standard Temperature Coefficient in ppm/°C	*Colour of First Two Bands or Dots*	
+100	red	violet
+33	green	blue
−47	blue	red
−1 500	orange	grey

A-1.4 It shall be made clear which band or dot is the first one, either:

a) by the surface of the first band or dot being at least twice the surface of the other bands or dots; or

b) by having a smaller gap between the first band or dot and the adjacent end, and a wider gap between the last band or dot and the other end.

A-1.5 The temperature coefficient shall be expressed in ppm/°C. The capacitance value shall be expressed in picofarads.

A-1.6 For tubular capacitors, bands should be used, where possible. The first band or dot shall be applied at the end where the termination for the inner conductor emerges.

A-1.7 The bands or dots shall be so placed and spaced that there shall be no confusion in reading the code. Any additional coding shall be so applied as not to confuse the coding for temperature coefficient, capacitance value and tolerance.

A-2. FIVE BAND OR DOT COLOUR CODE

A-2.1 The code with five bands or dots shall be in accordance with Table 2.

Example:

Capacitor of Type 1B, temperature coefficient −150 ppm/°C, rated capacitance 4·7 pF and tolerance ±0·1 pF (*see* Fig. 3).

TABLE 2 COLOUR CODING OF CERAMIC DIELECTRIC CAPACITORS WITH FIVE BANDS OR DOTS

Colour Type 1A, 1B and 1C	Temperature Coefficient, First Band or Dot	Capacitance Value				
		First Figure, Second Band or Dot	Second Figure, Third Band or Dot	Multiplier, Fourth Band or Dot	Tolerance, Fifth Band or Dot	
					Rated capacitance exceeding 10 pF	Rated capacitance up to and including 10 pF
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black	0	—	0	1	±20%	—
Brown	−33	1	1	10	± 1%	±0·1 pF
Red	−75	2	2	10^2	± 2%	±0·25 pF
Orange	−150	3	3	10^3	—	—
Yellow	−220	4	4	10^4	—	—
Green	−330	5	5	—	± 5%	±0·5 pF
Blue	−470	6	6	—	—	—
Violet	−750	7	7	—	—	—
Grey	—	8	8	10^{-2}	—	—
White	—	9	9	10^{-1}	±10%	±1 pF

NOTE — If it is inconvenient to apply the colour code, it is recommended that the temperature coefficient be indicated by a single body colour in accordance with this colour code, and the capacitance value and tolerance be given in figures.

A-3. SIX BAND OR DOT COLOUR CODE

A-3.1 The code with six bands or dots shall be in accordance with Table 3.

Example:

Capacitor of Type 1, temperature coefficient -100 ± 15 ppm/°C, rated capacitance 56 pF and tolerance ±5 percent (*see* Fig. 4).

TABLE 3 COLOUR CODING OF CERAMIC DIELECTRIC CAPACITORS WITH SIX BANDS OR DOTS

COLOUR	TEMPERATURE COEFFICIENT			CAPACITANCE VALUE				
	Significant Figure, First Band or Dot		Multiplier, Second Band or Dot	First Figure, Third Band or Dot	Second Figure, Fourth Band or Dot	Multiplier, Fifth Band or Dot	Tolerance, Sixth Band or Dot	
	Value	Tolerance					Rated capacitance exceeding 10 pF	Rated capacitance up to and including 10 pF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Black	—	—	-1	—	0	1	—	—
Brown	—	—	-10	1	1	10	±1%	±0·1 pF
Red	1·0	±0·15	-10^2	2	2	10^2	±2%	±0·25 pF
Orange	1·5	±0·25	-10^3	3	3	10^3	—	—
Yellow	2·2	±0·35	-10^4	4	4	10^4	—	—
Green	3·3	±0·6	1	5	5	—	±5%	±0·5 pF
Blue	4·7	±0·9	10	6	6	—	—	—
Violet	7·5	±1·2	10^2	7	7	—	—	—
Grey	—	—	10^3	8	8	10^{-2}	—	—
White	—	—	10^4	9	9	10^{-1}	±10%	±1 pF

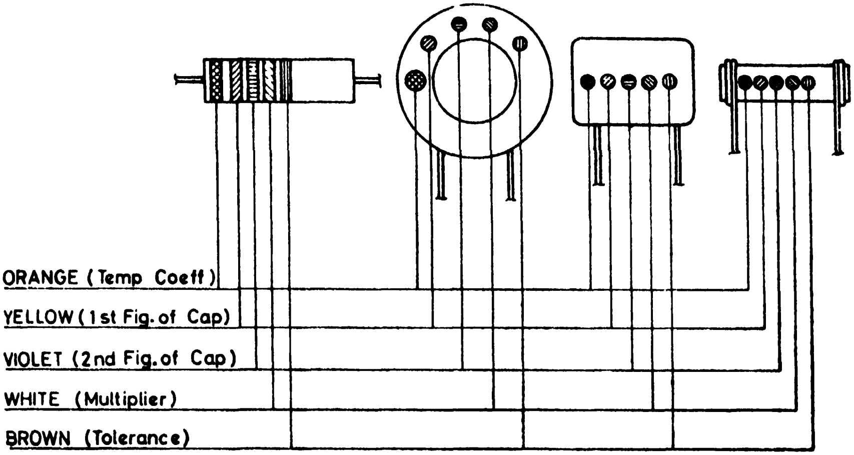


FIG. 3 COLOUR CODE FOR CAPACITORS (5 BANDS OR DOTS)

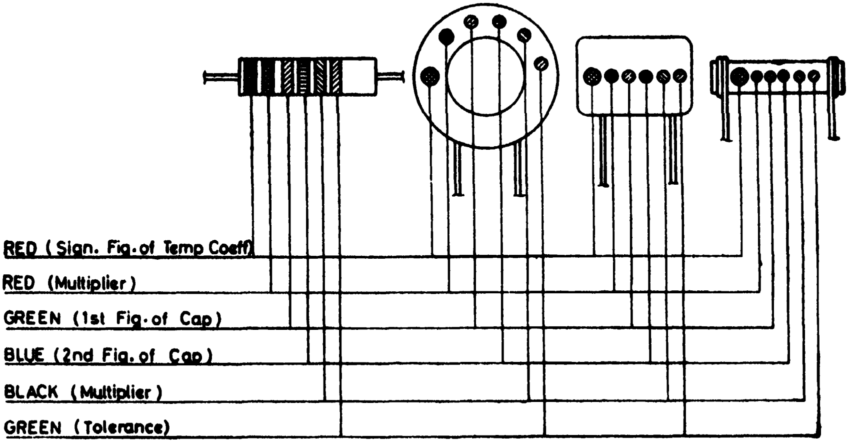
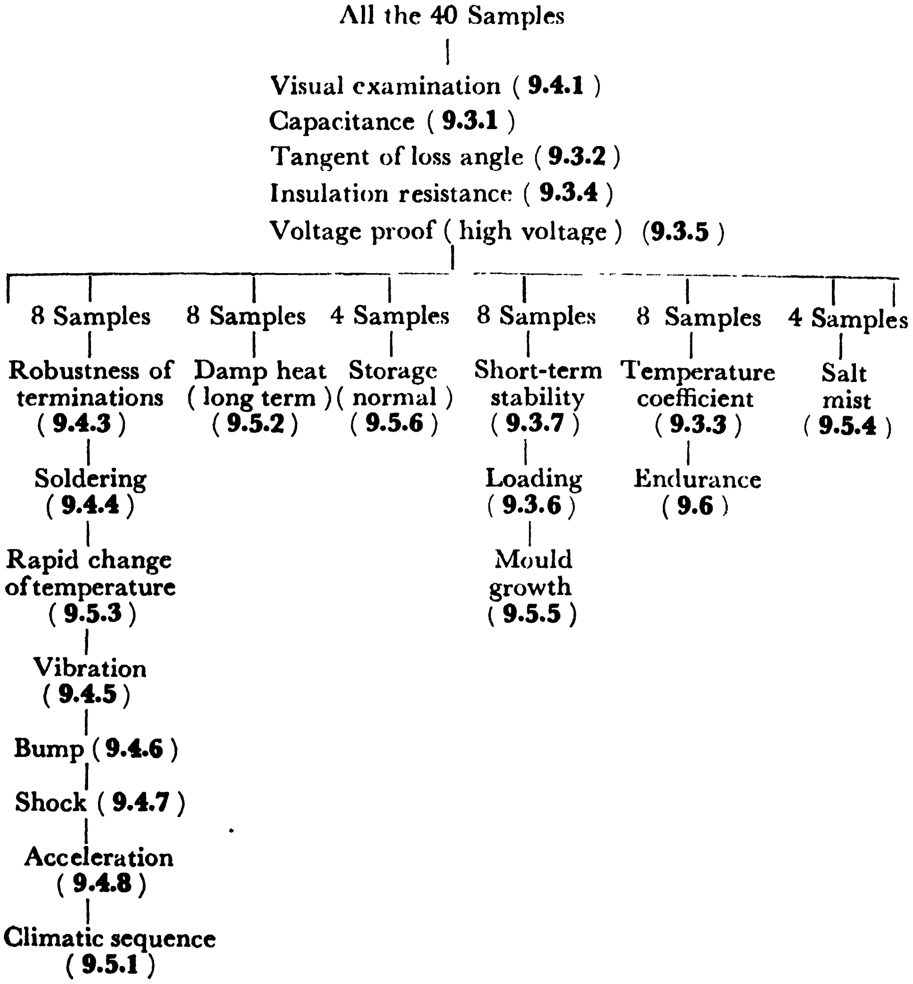


FIG. 4 COLOUR CODE FOR CAPACITORS (6 BANDS OR DOTS)

APPENDIX B

(*Clause* 9.1.1.3)

SEQUENCE OF TYPE APPROVAL TESTS


All the 40 Samples
Visual examination (**9.4.1**)
Capacitance (**9.3.1**)
Tangent of loss angle (**9.3.2**)
Insulation resistance (**9.3.4**)
Voltage proof (high voltage) (**9.3.5**)
8 Samples
Robustness of terminations (**9.4.3**)
Soldering (**9.4.4**)
Rapid change of temperature (**9.5.3**)
Vibration (**9.4.5**)
Bump (**9.4.6**)
Shock (**9.4.7**)
Acceleration (**9.4.8**)
Climatic sequence (**9.5.1**)
8 Samples
Damp heat (long term) (**9.5.2**)
4 Samples
Storage (normal) (**9.5.6**)
8 Samples
Short-term stability (**9.3.7**)
Loading (**9.3.6**)
Mould growth (**9.5.5**)
8 Samples
Temperature coefficient (**9.3.3**)
Endurance (**9.6**)
4 Samples
Salt mist (**9.5.4**)

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